CLAIMS

What is claimed is:

1. A method for generating a domain patterned Ferroelectric structure comprising:
   a. depositing a conductive layer on a top surface of a Ferroelectric material and a bottom surface of a Ferroelectric material, the top surface and the bottom surface of the Ferroelectric material corresponding to surfaces substantially normal to the z-polarization vectors of the Ferroelectric material;
   b. applying a sufficient bias voltage across the conductive layer on the top surface and the conductive layer on the bottom surface to pole the z-polarization vectors into a first orientation; and
   c. applying a sufficient bias voltage to selected portions of the conductive layer on the top surface on the Ferroelectric material and the conductive layer on the bottom surface of the Ferroelectric material to orient corresponding portions of the z-polarization vectors to a second orientation.

2. The method of claim 1, wherein the conductive layer comprises a conductive polymer in contact with the top surface and the bottom surface of the Ferroelectric material.

3. The method of claim 2, wherein the conductive polymer comprises is n–Methyl pyrrolidone.

4. The method of claim 2, wherein the conductive layer further comprises a salt

5. The method of claim 4, wherein the salt is a polyaniline salt.

6. The method of claim 2, wherein the conductive layer further comprises a metal deposited onto the conductive polymer.

7. The method of claim 1, wherein the selected portions of the conductive layer on the top surface of the Ferroelectric material are selected by patterning the conductive layer on the top surface of the Ferroelectric material.

8. The method of claim 7, wherein the conductive layer on the top surface of the Ferroelectric material is patterned by:

a. forming a mask over the conductive layer on the top surface of the Ferroelectric material;

b. selectively removing the exposed portion of the conductive layer on the top surface of the Ferroelectric material; and

c. removing the mask.

9. The method of claim 8, wherein the mask is formed from a photo-resist.

10. The method of claim 9, wherein the mask is formed by:

a. depositing the photo-resist on the conductive layer on the top surface of the Ferroelectric material;

b. exposing areas of the photo-resist with a light source according to a predetermined pattern; and

c. developing the photo-resist to remove the unexposed portions of the photo-resist.

11. The method of claim 1, further comprising the steps of placing the conductive layer on the top surface of the Ferroelectric material and the conductive layer on the bottom surface of the Ferroelectric material in electrical communication.

12. The method of claim 11, wherein the step of placing the conductive layer on the top surface of the Ferroelectric material and the conductive layer on the bottom surface of the Ferroelectric material in electrical communication is performed after applying the sufficient bias voltage across the conductive layer on the top surface and the conductive

layer on the bottom surface to pole the z-polarization vectors into the first orientation.

13. The method of claim 11, wherein the conductive layer on the top surface of the Ferroelectric material and the conductive layer on the bottom surface of the Ferroelectric material are placed in electrical communication by applying a conductive polymer to side surfaces of the Ferroelectric material.

14. The method of claim 13, further comprising:

a. removing the conductive polymer from the side surfaces of the Ferroelectric material prior to applying the sufficient bias voltage to selected portions of the conductive layer on the top surface and the conductive layer on the bottom surface of the Ferroelectric material; and

b. reapplying the conductive polymer to the side surfaces of the Ferroelelctric material after applying the sufficient bias voltage to the selected portions of the conductive layer on the top surface of the Ferroelelctric material and the conductive layer on the bottom surface of the Ferroelectric material.

15. The method of claim 1, wherein the Ferroelectric material is a wafer structure comprising Lithium.

16. The method of claim 15, wherein the wafer further comprises an element selected from the group consisting of Tantalum and Niobium.

17. The method of claim 1, wherein the Ferroelectric structure is a wafer that is formed from a material selected from the group consisting of $LiNbO_3$ or $LiTaO_3$.

18. The method of claim 17, wherein the wafer is annealed in the presence of a corresponding Li-rich $LiNbO_3$ or a $LiTaO_3$ powder, thereby producing a low coercive field Ferroelectric wafer structure.

19. The method of claim 1, wherein the Ferroelectric material exhibits spontaneous domain reversal with changes in temperature of less than 40 degrees Celsius, wherein $\Delta T = q^{-1} \cdot \xi \cdot E_c$, and wherein q is the pyroelectric coefficient, ξ is the permitivity of the Ferroelectric and E_c is the coercive field.

20. The method of claim 1, wherein the Ferroelectric material exhibits spontaneous polarization with changes in temperature of less than 10 degrees Celsius, wherein $\Delta T = q^{-1} \cdot \xi \cdot E_c$ and wherein q is the pyroelectric coefficient, ξ is the permitivity of the Ferroelectric and E_c is the coercive field.

21. The method of claim 1, wherein the Ferroelectric material exhibits a coercive field value E_c of 3 kV/mm or less.

22. The method of claim 1, wherein the Ferroelectric material is a wafer with an edge surface and, wherein the conductive layer on the top surface of the wafer and the bottom surface of the wafer are deposited a distance within 2.0 mm or less from the edge surface.

23. A quasi-phase matching structure comprising having spatially modulated nonlinear domains capable of generating a harmonic emission wave form with a wavelength λ_e from a fundamental wave form of an interacting light source with a wavelength λ_i the structure being formed from a Ferroelectric material which exhibits a spontaneous domain reversal with changes in temperature of less than 25 degrees.

24. The quasi-phase matching structure of claim 23, wherein the Ferroelectric material is selected from the group consisting of $LiNbO_3$ or $LiTaO_3$.

25. A harmonic generator for generating a harmonic emission wave form with a wavelength λ_e from a fundamental wave from with a wavelength λ_i, the system comprising:

a. A quasi-phase matching structure formed from a Ferroelectric material which

exhibits spontaneous domain reversal with temperature changes of less than 40 degrees, the structure comprising spatially modulated nonlinear domains; and

b. a light source capable of emitting a fundamental wavelength λ_i and being configured to be incident with the quasi-phase matching structure such that a portion of the light with the fundamental wavelength λ_i interacts with the spatially modulated nonlinear domains and generates the a harmonic emission wave form with a wavelength λ_e.

26. The harmonic generator of claim 25, the Ferroelelctric material is selected from the group consisting of $LiNbO_3$ or $LiTaO_3$.

27. The harmonic generator of claim 25, wherein the generator is configured to generate the second harmonic wave form for the light source with a wavelength λ_i is in the range of 300 to 5000 nanometers.

28. The harmonic generator of claim 25, further comprising a lens for focusing the light source incident with the quasi-phase matching structure.

29. The harmonic generator of claim 25, wherein the Ferroelectric material is treated to an alternating poling voltage, whereby the voltage poles the Ferroelectric material into a finite orientation.

30. The harmonic generator of claim 29, wherein Ferroelectric material is treated to an alternating poling voltage at an elevated temperature.

31. The harmonic generator of claim 30, wherein the elevated temperature is in a range between 100 and 200 degrees Celsius.

32. A method for generating a harmonic wave form with a wavelength λ_e from a fundamental

wave form with a wavelength λ_i, the method comprising:

a. providing a quasi-phase matching structure formed from a Ferroelelctric material which exhibits spontaneous domain reversal with temperature changes of less than 40 degrees, the structure comprising spatially modulated nonlinear domains; and

b. focusing a light source with a wavelength λ_i on a portion of the quasi-phase matching structure such that a portion of the incident light interacts with the quasi-phase matching structure,

thereby generating the a harmonic wave form with a wavelength λ_e.